

MATERIAL SAFETY DATA SHEET

SRM Supplier: National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Mail Stop 2321
Gaithersburg, Maryland 20899

SRM Number: 1622e
MSDS Number: 1622e
SRM Name: Sulfur in Residual Fuel Oil

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See MSDS Revision History on Last Page

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SECTION I. MATERIAL IDENTIFICATION

Material Name: Sulfur in Residual Fuel Oil

Description: A high viscosity residual oil; mixture of petroleum hydrocarbons (paraffinic, olefinic, naphthenic and aromatic). A fuel oil of low sulfur content; this SRM has a nominal sulfur mass fraction of 2 %. SRM 1622e consists of 100 mL of commercial "No. 6" residual fuel oil.

Other Designations: Sulfur (brimstone; sulphur) in Residual Fuel Oil (Fuel Oil No. 6)

Name	Chemical Formula	CAS Registry Number
Residual Fuel Oil	complex mixture	68553-00-4

DOT Classification: Not regulated by DOT

Manufacturer/Supplier: Available from a number of suppliers

SECTION II. HAZARDOUS INGREDIENTS

Hazardous Component	Nominal Concentration (%)	Exposure Limits and Toxicity Data
Residual Fuel Oil No. 6	~ 100	OSHA TLV-TWA: 5 mg/m ³ (mineral oil mist)
		Rat, Oral: LD ₅₀ : 5.1 g/kg
		Rat, Oral: LD ₅₀ : 5300 mg/kg

SECTION III. PHYSICAL/CHEMICAL CHARACTERISTICS

Residual Fuel Oil No. 6	
Appearance and Odor: a black liquid to heavy paste with a petroleum odor.	Boiling Point: > 351 °C
Density (@ 15 °C): 1005.1 kg/m ³ *	Pour Point: 14 °C
Kinematic Viscosity (@ 40 °C): 1763 • 10 ⁻⁶ m ² /s (1763 cSt)*	Freezing Point: not available
Kinematic Viscosity (@ 50 °C): 776.9 • 10 ⁻⁶ m ² /s (776.9 cSt)*	Heat of Combustion: 42.49 MJ/kg
Kinematic Viscosity (@ 100 °C): 54.7 • 10 ⁻⁶ m ² /s (54.74 cSt)*	Water Solubility: negligible

*Values were obtained from physical tests and measurements of SRM 1622e. The analyses were performed using ASTM methods by a commercial firm under contract to the National Institute of Standards and Technology.

SECTION IV. FIRE AND EXPLOSION HAZARD DATA

Flash Point: 77 °C*

Method Used: PMCC*

Autoignition Temperature: 407.22 °C

Flammability Limits in Air (Volume %): UPPER: 5
LOWER: 1

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Unusual Fire and Explosion Hazards: Heating this material greatly increases the fire hazard.

Special Fire Procedures: Fuel Oil No. 6 is an OSHA Class IIIA combustible liquid. Fire fighters should wear self-contained breathing apparatus (SCBA) and full protective clothing.

SECTION V. REACTIVITY DATA

Stability: X Stable Unstable

Conditions to Avoid: Avoid contact with incompatible materials.

Incompatibility (Materials to Avoid): Keep this fuel from strong oxidizers.

Hazardous Decomposition or Byproducts: Thermal decomposition may release hydrocarbons and hydrocarbon derivatives: carbon dioxide, carbon monoxide, and sulfur dioxide.

Hazardous Polymerization Will Occur X Will Not Occur

SECTION VI. HEALTH HAZARD DATA

Route of Entry: X Inhalation X Skin X Ingestion

Health Hazards (Acute and Chronic): The inhalation hazard of this material is low unless the oil is heated or misted. The residual oils have a lower aspiration hazard since heavy oils are more viscous. Aspiration is generally limited to inhalation from vomiting after ingestion. High concentrations of the vapor or mist may cause respiratory tract irritation and possibly symptoms of central nervous system (CNS) depression. Other symptoms include headache, dizziness, nausea, stupor, convulsions, or unconsciousness depending on the concentration and duration of exposure. Repeated or prolonged inhalation of fumes or mist may cause irritation.

Skin contact with this residual fuel oil may result in mild irritation and if allowed to remain on the skin, may cause burning and redness. In animal testing, skin application of four different test groups for a 24 hour period produced no deaths in three of the test sets; one test group resulted in 37.5 % mortality at a concentration of 5 g/kg. This dose produced weight loss and lethargy. Gross necropsy revealed acute toxic hepatitis, gastrointestinal irritation and congested lungs.

Repeated or prolonged dermal contact may cause defatting of the skin, which may result in dermatitis. It may also cause blockage of the sebaceous glands with a rash of acne-like pimples and spots, which usually occur on the arms and legs. A guinea pig test group exposed to four identical fuel oil No. 6 samples resulted in one case of induced mild sensitization with erythema and edema. Rabbit test groups exposed to four different fuel oil concentrations ranging from 1 mL/kg to 8 mL/kg applied to the skin, resulted in mortality rates ranging from 0 % to 75 %. The animals suffered from severe dermal irritation with fissuring and thickening of the test site. Depression and anorexia were the primary causes of death and were induced by dermal irritation with infection rather than systemic toxicity. Necropsy revealed hemorrhagic and pale yellow, mottled livers with multifocal necrosis and organ deterioration. Skin application to mice of heavy fuel oil resulted in benign and malignant skin tumors.

Eye contact with fuel oil No. 6 may cause irritation. Repeated or prolonged exposure may cause conjunctivitis.

Ingestion of residual fuel oil causes gastrointestinal irritation and the oil produces a laxative effect. Toxicity by ingestion is relatively low since intestinal absorption of long-chain hydrocarbons is poor. In animal testing, lethal amounts of the oil resulted in gastrointestinal irritation, hemorrhagic gastroenteritis, and pneumonia. The cause of death was believed to be physical trauma rather than metabolic dysfunction.

Medical Conditions Generally Aggravated by Exposure: Persons with pre-existing allergies and skin or respiratory disorders.

Listed as a Carcinogen/Potential Carcinogen:*

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens		X
In the International Agency for Research on Cancer (IARC) Monographs	X	
By the Occupational Safety and Health Administration (OSHA)		X

*The IARC lists residual (heavy) fuel oils, as a *possible human carcinogen (Group 2B)* and an *animal sufficient evidence*. Skin application to mice of cracked bunker fuel, both alone and blended, induced benign and malignant skin tumors.

EMERGENCY AND FIRST AID PROCEDURES:

Skin Contact: Remove contaminated shoes and clothing. Rinse affected area with large amounts of water followed by washing the area with soap and water. Watch for chemical irritations and treat them accordingly. Contact medical assistance if necessary.

Eye Contact: Immediately flush eyes, including under the eyelids, with copious amounts of water for at least 15 minutes. Contact medical assistance if necessary.

Inhalation: If inhaled, move the victim to fresh air. If breathing is difficult, give oxygen; if the victim is not breathing, give artificial respiration. Contact medical assistance if necessary.

Ingestion: If ingestion occurs, wash out mouth with water. **DO NOT** induce vomiting. Contact medical assistance.

TARGET ORGAN(S) OF ATTACK: skin, eyes, upper respiratory tract (URT), liver, and digestive system

SECTION VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be taken in Case Material is Released: Notify safety personnel of leaks and spills. Remove sources of ignition and provide adequate ventilation. Personnel performing the clean-up should use protection against contact with the liquid and vapor and/or mist inhalation. Contain the spill by diking. Small spills can be contained by absorbents, such as rags, straw, polyurethane foam, activated carbon and sand. Clean up spills promptly to reduce fire or vapor hazards. Large spills must be reported to the proper authorities.

Waste Disposal: Follow all federal, state and local laws governing disposal.

Handling and Storage: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the TLV. Provide approved respiratory apparatus for non-routine or emergency use. Use an approved filter and vapor respirator when the vapor or mist concentrations are high. An eye wash station and washing facilities should be readily available near handling and use areas. Wash exposed skin areas several times a day with soap and warm water.

NOTE: Contact lenses pose a special problem; soft lenses may absorb irritants and all lenses concentrate them. **DO NOT** wear contact lenses in the laboratory.

Store material in a cool, dry, well ventilated area away from sources of heat, sparks, open flames, and oxidizing agents. Protect containers from physical damage.

SECTION VIII. SOURCE DATA/OTHER COMMENTS

Sources: MDL Information Systems, Inc., MSDS *Residual Fuel Oil No. 6*, 16 December 2002.
Hawley's Condensed Chemical Dictionary, 11th Ed., 1987.
The American Heritage: Stedman's Medical Dictionary, 1995.

MSDS Revision Date History: 02 April 2003 (This revision reflects a change in the carcinogenic status by IARC and editorial changes); 10 April 1997 (Original MSDS date).
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Disclaimer: Physical and chemical data contained in this MSDS are provided only for use in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data on the MSDS. The certified values for this material are given on the NIST Certificate of Analysis.